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Creativity, Imagination and Being in the Image of God: a *Précis* of *The Poetry and Music of Science*

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The Poetry and Music of Science (McLeish 2019) is centrally about human stories of *poesis*, of bringing into existence that which was not, and the narratives that weave the fabric of those stories. Its writing is itself an example of such a ‘narrative of creation.’ On my occasional high-school visits to engage students on the history and philosophy of science, I am often impressed by their critical abilities and intelligence, but frequently wonder why at least some of the really bright ones choose not to study science at this level. Far too often I get answers along the lines of, “I didn’t see any role for my own creativity or imagination.” At this point I know that something has gone terribly wrong in the message young people are receiving about science – that it is simply a body of ‘facts’ to learn, a set of known questions with right ‘answers’. Yet working scientists know that without imagination there can be no progress in science at all, and that formulating the right *questions*, not answers, is the central and critical step in our inspirational calling to ‘re-imagine the universe’.

What seems to have happened is that what I would now call the ‘second half of the scientific method’ – that is the way that we test our ideas when we have had them, has dominated all discussion of the way science is done, so that the first, and more important half has been effectively silenced. There may be no formal ‘method’ for having the ideas or formulating the hypothesis in the first place, but that does not diminish the essential importance of ideation.

Historical shadows fall across this assumed unequal dispensation of creative imagination between the arts and the sciences. It is one aspect of the 20th century conflict launched by C.P. Snow’s (1959) *Two Cultures* Reith lectures and book, and which emerged a generation later in the ‘Science Wars’ between post-modern humanists and scientists. There are Romantic roots to the divergence as well: Keats and Poe both wrote famous poetic invectives against the science they perceived would ‘unweave a rainbow’, and this while their contemporary Wordsworth (1802) foresaw, albeit dimly, the day when science would inspire poetry as naturally as any other human endeavour. The historical journey to find its source finds the 18th century poet and artist William Blake (1988) contrasting his task to ‘create’ in opposition to the ‘reason’ of ‘Bacon, Locke and Newton.’ Yet the testimony of scientists aligns more with Wordsworth. Einstein always held imagination in the highest regard, and essential for science. For him it ‘encircles the world.’ Ada Lovelace would find poetic inspiration stronger after a week of mathematical contemplation.

Listening to Stories of Creativity

I determined to explore where the threads that bind science to the creative imagination had become unravelled. This led to a long journey into its history, philosophy and theology, but I decided to begin simply by asking colleagues to tell me the story behind their most cherished idea or discovery. I didn’t want the polished results and the covered tracks, but the unvarnished truth of how science is actually done, from biophysics to materials science to astronomy. They gave fascinating accounts of curiosity, initial trials, chance encounters repeated frustrations and, in fortunate cases, illuminations that often seemed to come effortlessly, as ‘gifts’, and during moments of rest or mental relaxation.

I felt enabled to reflect more deeply on my own experiences of seeking, and sometimes finding, scientific ideas in the imagination—the macromolecular picture that began as a dance in my mind’s eye; the long-sought structural geometry of a two-phase fluid that came in a dream; the sudden and simultaneous realisation of what a polymer network was doing as a colleague and I glanced at each other and shared the same thought... I also asked the same questions, as a sort of ‘control’ of artists, composers, poets and writers. Would their stories of creativity differ markedly from those of the scientists? The first remarkable (for me) discovery from those conversations was that, just as the scientists tended to be shy about the inspiration phase of their work, so the artists were a little coy at first about just how much experiment, re-working, encounter with material constraints, they themselves experienced in their own work. I have often heard scientists say of, say, novelists, ‘it’s all very easy for you – you can make your characters do just as you please; we have to get things right!’. Nothing could be further from the truth. It turns out that thinking of creativity as the outward and explosive force of the imagination being met and formed into something true and beautiful by the world’s constraints, is just as true a generalisation of science as of art.

Three Creative Modes of Imagination

The original plan for *The Poetry and Music of Science*, however, refused to be written. I thought at first that an account of scientific creation, would be followed by material from conversations with the artists, composers and writers, motivating a final discussion of the similarities and differences. Yet to divide scientific and artistic creativity along the ‘Two Cultures’ lines in this way just wasn’t faithful to the experiences I was hearing about, nor to the rare but occasional accounts of creativity in science and the arts, such as the physiologist William Beveridge’s 1950 book *The Art of Scientific Investigation*, which deliberately echoes novelist Henry James’ earlier *The Art of the Novel*. This is not to claim that creativity knows no categorization. I do not claim that the scheme that suggested itself to me is the only possible, or even the best, but it was faithful to the testimony and material I harvested. Both science and art seem to share three imaginative modes, each transgressing the art-science boundaries, yet tangibly differing in operation from each other. I have termed them the visual, the textual and the abstract.

The first is the realm of visual art, and of visual conception in science from cosmology to biophysics. Visual thinking is so powerful that it endows us with our normal metaphor for understanding itself – ‘I see!’ Plato thought that vision itself was an ‘extramissive’ process – that visual rays *from* our eyes alight upon objects and allow us to perceive them. I have come to hesitate before criticising such old and ‘unscientific’ ideas hastily: modern neuroscience teaches us just how much we create what we think we see. That is after all what ‘Bayesian inference’ means. Seeing is indeed a creative process, and arguably science itself can be defined as an extension of our visual perception. Theoretical science creates internal vision in our ‘mind’s eye’ into the smallest biological cells or out into the processes at the heart of distant galaxies; experiment enhances our vision directly with microscopes and telescopes. There are close parallels between scientific imagination and expressionist art, where the viewer’s plane of focus is perpetually redirected between the two ‘planes’ of the canvas and the world behind it. The great ‘Discarded Image’ of the ancient and medieval cosmos becomes the ur-text of the visual imagination’s task to create a fully three-dimensional structure from a two-dimensional projection. Much mathematical conception is essential visual.

The second mode of imagination employs words and text, rather than image. The story here begins with the coincident but not coincidental origin of the experimental method and the literary novel. We find Daniel Defoe writing the ‘experiment’ of *Robinson Crusoe* in the same mode as Robert Boyle’s new style of scientific writing, and even claiming that the novel was an authentic record of diarized events. Margaret Cavendish (1666), the great natural philosopher of the late 17th century, chooses a novelistic ‘science fiction’ setting – in her *Blazing World* – to mount her most serious critique of the new ‘experimental philosophy’. The mutual entanglement of imaginative writing and science continues from Newton and Milton, via Goethe and Humboldt, to Coleridge and Davy. Priestly was able to remark how novels resembled scientific instruments to him – they are the orreries of human dynamic. Then in Wordsworth we find an almost prophetic glimpse into two possible futures, one in which science grows to inspire the great poetry of the future, and another in which its structures, powers and beauties fail to achieve a universal cognizance, and so retreats into an exclusive world of the technical and abstruse. Sadly, the latter future seems to be the one we have inherited, for now at least.

The third imaginative domain is the miracle of the wordless, picture-less worlds of music and mathematics. At the point at which there are no images and no words left to us, and when we expect a conceptual vacuum, there we find these transcendent wonders. An assumed connection between music and mathematics has become a conversational commonplace, but I do not think we really understand it. The occurrence of numbers in both is really a misleading commonality – the numerical is not the core essence of mathematical structures; nor is it at the centre of musical creativity. The family relationship becomes clearer at the deeper level of harmonic patterns and sequences of music, and at the partially resolved architectures of mathematical reasoning. To discover this requires not only a broad panoramic gaze over the fields, but also deep-dives into the creation of particular examples. Sitting at the feet of scholars in literature, music and mathematics has been one of the most satisfying experiences of the project – one pay-off for example was the privilege of working with Durham musicologist Julian Horton over an analysis of my favourite piece of music, Robert Schumann’s *Konzertstück* for four horns and orchestra. Not only does this musical glory deserve a published structural analysis, but the epoch of its writing coincides with the fragmentation of disciplines in the 19th century that runs parallel with a silencing of conversation on imagination in science. Horton’s insight, that the really great composers are set apart by their ability to ‘set themselves harmonic problems and solve them’ on the way to constructing entire works, resonates strongly with the imaginative power required to create mathematical proofs.

The Emotions of Thought and the ‘Creativity Narrative’

Detailed examination of the three imaginative modes also uncovered a truth that may be uncomfortable to some: thought and emotion are inseparable in all stories of creativity. In our late modern world we pretend that cognition and rationality can be divorced from the affective currents in our minds. It turns out that David Hume (2007) was attuned to this deception – maybe this is one reason that Einstein, so aware of the vital imaginative energies of science, read him with such avidity. But the last era that saw a wide, communicated and nuanced contemplation of creative impulses turns out to be the medieval. Anselm, Grosseteste and Aquinas knew – surely through longer, deeper and more unhurried internal gaze than we habitually permit ourselves – that emotions are not just pinned to the start (desire) and end (joy) of the creative process, but weave their way throughout the stages of conception, trial, retreat, incubation, inspiration, and refinement. There is no creative endeavour today that

resides entirely in the emotion-free cognitive world of abstract and arid thought. Pure mathematics generates affective response as great as those engendered by music, verse or art.

That very structure to the creative process leads to the slow dawning of another realisation – that in the human miracle of *poiesis* that brings structure and beauty into existence where there was nothing before – there is a great *narrative*. Christopher Booker is one of those writers who have attempted a categorisation of the ‘great plots’ of all human stories. He lists the love story, the great battle of good and evil, the journey home and the ‘quest’ among other ur-stories of literature and experience. But the human story of the creative act seems to be another, although omitted from such lists. It is the ultimate romantic adventure – all creativity begins with a desire reach a dimly-perceived goal, whether that be a sonnet on a visage or the science of vision. There is surprise on the meeting of unexpected constraints, whether of oil-paint on canvas or of observational data. The frustration and despair at inability to progress is shared by those experiencing writer’s block as much as wrong predictions of an experiment. The resignation of time spent fallow, the moving on to other matters when all seems hopeless, is shared by composers and chemists, but so is the occasional joy when the wonderful and under-researched subconscious creative processes of the human mind throw up solution strategies at the most unexpected moments. This is not an original observation; the literature on creativity contains a number of diachronic schemes that seek to generalize the tortuous journey from conception to realization. The oldest complete and faithful articulation I found, quite charmingly, in Anselm’s *Proslogion*, yet the core ideas that *poiesis* has a narrative is in Aristotle. Henry James and William Beveridge both adopt very similar schemes of ideation, observation, incubation, illumination and verification, encapsulated famously by Graham Wallas in his 1926 book *The Art of Thought*. Yet I did not expect to have to read my way into the literature of narrative analysis, or of left and right brain lateralisation, but it turns out that an account of creativity is impossible without them.

The role of non-conscious layers of the mind in the processes of imagination and creativity becomes increasingly undeniable on listening to multiple accounts, and in varied spheres, of creative journeys. Psychological studies are very limited (not that they are not numerous), for the more relevant the experiences, the less they are amenable to laboratory conditions. One mental attitude, or habit, is striking, however. I describe it as an elliptical orbit of thought – one that engages its object at regular perigees of close engagement, intercalated with apogees of more distant and contextualizing contemplation. Iain McGilchrist (2009) would associate these two mental stances as dominated by left and right cerebral hemispheres respectively. Their duality appears in all three imaginative ‘modes’ and traces the ‘creation narrative’.

Creativity and Purpose

The final surprise the book had for its author was the suggestion of a new task – to account for the deeply-felt human purpose in bringing the new into being. There is a *teleology* to creativity. Here the discipline of theology is unique in bringing its critical tools to bear on illuminating this deepest seam of all. The drive to bring order out of chaos, to seek for beauty and understanding where dullness and ignorance lay before, draws on profound commonalities within religious traditions. The study of creativity demonstrates, for example, that to ask ‘how one reconciles’ science and religion, is profoundly the wrong question. Until the last century or so, the moral and purposive framing of natural discovery had been assisted by the traditions of contemplation and theology. I was led once more (McLeish 2014) to sources such as the incomparable *Book of Job*, found buried in the central pages of the Old Testament, that contains such jewels as the ‘Hymn to Wisdom’ in which human insight into the deep material

structures of the world is compared to the unique vision of the miner into the underground structures of the Earth. The ‘visual mode’ of scientific imagination appears in ancient attire here. Job links knowledge of the world to the heart of wisdom itself, and the ability of humans to see deeply into the structures of the world as an aspect of sharing in the divine. There is insight here into the Biblical mystery of the *Imago Dei* – the idea that human beings are in some sense ‘in the image of God’. How this extraordinary idea is to be interpreted has spawned theological debate down the centuries, but one way to think about it that brings the huge potential, yet great responsibility of *homo sapiens* into focus, is through creativity itself. We, too, create, and so alter and grow the world around us.

Thinking about creativity in this way leads to serious consequences for how we teach science at school or share it in public, and for how we train our researchers, even in entirely secular contexts. I cannot recall a single discussion during my own formation as a scientist of what practices, disciplines, rhythms of work and relaxation, types of reading or directions of thought might encourage that vital visit from the scientific muse. When challenged about this, many colleagues expressed doubt that anything at all can be said. As traditionally formulated, the scientific method describes only the Popperian ‘second phase’ of the process—testing ideas, still trailing its over-neat and bloodless recipe of falsification. There is no method, it is claimed, for having ideas. But this does not imply that there is an impossibility of good advice. We know that innovation rarely emerges from exposure to narrowly conventional thinking. This is why interdisciplinary conversation is so important. Time spent talking across boundaries causes ideas to spark over the highly-charged disciplinary gaps, shocking us into new modes of thinking. My own case has benefitted from such experiences of ‘radical interdisciplinarity’. Working with medieval scholars on the 13th century science of Robert Grosseteste has, unexpectedly, inspired some of the freshest contemporary scientific work I have enjoyed. Furthermore, those ‘aha’ moments—which more than one scientist has told me are what they live for—never come when the conscious mind is busy. They are the product of the unconscious winnowing of apparently fruitless weeks of labour into fresh thought. They will never arrive unless we give them the space to do so. Hence the need to alternate hard work with experiencing liminal moments of changing mental space – the ‘elliptic orbit’ of engagement and contemplation, or, if you like, of the inspection of the impressionist’s brush=strokes and the distant gaze onto the entire canvas.

Perhaps by sharing more openly what the sciences, arts and humanities have in common, as human endeavours of creativity, we might be able to move the public framing and enjoyment of scientific ideas back onto the track that Wordsworth, Goethe and Humboldt enacted in their own inspirational prose and poetry, and foresaw developing in future. To do this we will need to talk more honestly and openly about the stories of science, its groping in darkness as much as its illumination, its contemplative practice as much as its generation of understanding, its way to wisdom as much as its path to knowledge.

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